PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

John Guy ALLEN

Application No.: NEW U.S. SECURITY PATENT APPLICATION

Filed: October 22, 1997 Docket No.: JAO 40247

For: AFTERBURNER IGNITER

CLAIM FOR PRIORITY (SINGLE)

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

The benefit of the filing date of the following prior foreign application filed in the following foreign country is hereby requested for the above-identified patent application and the priority provided in 35 U.S.C. §119 is hereby claimed:

Great Britain Patent Application No. 9623196.4, filed November 7, 1996

In support of this claim, a certified copy of said original foreign application:

_x_ is filed herewith.

___ was filed on _____ in Parent Application No. _____ filed _____.

It is requested that the file of this application be marked to indicate that the requirements of 35 U.S.C. §119 have been fulfilled and that the Patent and Trademark Office kindly acknowledge receipt of this document.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Joel S. Armstrong
Registration No. 36,430

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I further certify that pursuant to Section 22(1) of the Patents Act, 1977, the Comptroller has ordered prohibition of publication of the said specification.

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Dated 25 SEP 1997

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(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference
   DY 2553

2. Patent application number
   (The Patent Office will fill in this part)
   9623196.4

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*
   ROLLS-ROYCE plc
   65 BUCKINGHAM GATE
   LONDON SW1E 6AT

   Patents ADP number *(if you know it)* 00003970002

   If the applicant is a corporate body, give the country/state of its incorporation ENGLAND

4. Title of the invention
   AFTERBURNER IGNITER

5. Name of your agent *(if you have one)*

   "Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*
   H C CHAPMAN
   ROLLS-ROYCE plc
   PATENTS DEPARTMENT
   PO BOX 31
   DERBY DE24 8BJ

   Patents ADP number *(if you know it)* 07974050001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
   a) any applicant named in part 3 is not an inventor, or
   b) there is an inventor who is not named as an applicant, or
   c) any named applicant is a corporate body.
   See note (d))

   YES

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	5
Claim(s)	1
Abstract	1
Drawing(s)	3

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	2
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	1
Any other documents *(please specify)*	DEPOSIT ACCOUNT FEE SHEET

11. I/We request the grant of a patent on the basis of this application.

Signature H C Chapman Date 6.11.96

H C CHAPMAN

12. Name and daytime telephone number of person to contact in the United Kingdom — H C CHAPMAN — 01332 249452

Warning

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The Patent Office

Statement of inventorship and of right to grant of a patent

The Patent Office
Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference

   DY 2553

2. Patent application number
   (if you know it)

   9623196.4

   0 7 NOV 1996

3. Full name of the or of each applicant

   ROLLS-ROYCE plc

4. Title of the invention

   AFTERBURNER INJECTOR

5. State how the applicant(s) derived the right from the inventor(s) to be granted a patent

   BY VIRTUE OF AN ASSIGNMENT DATED 6 NOVEMBER 1996

6. How many, if any, additional Patents Forms 7/77 are attached to this form?
   (see note (c))

   1

7. I/We believe that the person(s) named over the page *(and on any extra copies of this form)* is/are the inventor(s) of the invention which the above patent application relates to.

   Signature [signature] Date

   H C CHAPMAN 6.11.96

8. Name and daytime telephone number of person to contact in the United Kingdom

   H C CHAPMAN 01332 249452

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Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

JOHN GUY ALLEN
25 BEVINGTON CLOSE
PATCHWAY
BRISTOL

7097421002

Patents ADP number *(if you know it)*:

Patents ADP number *(if you know it)*:

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Reminder

Have you signed the form?

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AFTERBURNER IGNITER

This invention relates to gas turbine engines. More particularly but not exclusively this invention relates to a gas turbine engine afterburner.

Afterburning is a method of augmenting the basic thrust of a gas turbine engine to improve aircraft take-off, climb and in the specific case of military aircraft, combat performance. Additional fuel is introduced and burned between the turbine section of the engine and the jet pipe propelling nozzle utilising unburned oxygen in the exhaust gas to support combustion. The resulting increase in the temperature of the exhaust gas gives an increased velocity to the jet leaving the jet pipe nozzle and therefore increases the engine thrust.

Although the gas temperature in the jet pipe is extremely hot the afterburner cannot be relied upon to ignite spontaneously. Some form of ignition has to be provided, therefore, for reliable operation.

In hot-shot ignition a jet of fuel is injected into the combustion chamber outlet. The resulting hot streak of flame extends through the turbine into the jet pipe where it ignites the afterburner fuel fed into the jet pipe. This form of afterburner ignition necessitates the use of at least one fuel injector at least the tip of which extends into the combustion chamber.

A problem arising with the use of hot shot ignition is that carbon debris left by burnt or boiling fuel in the injector rapidly builds up. This debris has to be removed otherwise the injector becomes blocked and ceases to function. Regular examination and frequent preventative maintenance of the injectors is thus required. Unless the

injectors are easily accessed and removed this could mean aircraft has to be taken out of service.

It is believed that the generation of carbon debris is temperature related and its build-up occurs in the injectors delivery passage lying in the space between the combustion chamber outer casing and the wall of the combustion chamber where the temperature may be of the order of 130°C which is considerably less than the temperature of for example the area in which the combustion chamber where the nozzle is positioned and which temperature may be of the order of 1,300°C. The temperature gradient along the injector delivery passage has been found to be very steep and it is believed that this may be a primary cause of carbon debris build up. It is also believed that control of the thermal gradient as by ducting air over the injector or even by applying some form of thermal lagging to the body of the injector is likely to greatly retard the build up of such debris.

It is an object of the present invention to provide apparatus which at least partially removes the build up of carbon debris in the fuel delivery passage of the inspector of an afterburner hot-shot ignition unit thereby considerably extending injector examination and cleaning intervals and to provide improvements generally.

According to the present invention there is provided a gas turbine engine afterburner igniter comprising fuel duct means for injecting a jet of fuel into a gas stream directed into a combustion chamber characterised in that moveable resilient means is provided within said fuel duct means such that during operation said resilient means moves relative to said duct means due to the passage of fuel within said fuel duct so as to abrade at least some of the internal surface of the bore of said duct.

The invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a schematic form of an axial gas turbine engine partly in section and including a combustion chamber and part of the turbine and exhaust jet pipe, together with a hot-shot fuel ignition apparatus.

Figure 2 is a part cross section through the injector of the hot-shot fuel ignition apparatus of figure 1.

Figure 3 is a part cross section through an injector in accordance with the present invention. As shown in figure 1 a gas turbine engine 1 includes a compressor indicated generally at 2, a combustion chamber 3 with an igniter plug 4 and a conventional fuel spray apparatus 5 for spraying fuel into a stream of compressed air from the compressor, a turbine 6 and a jet pipe 7. The combustion chamber is defined by a wall 8 outside which is an outer casing 9 and an enclosing wall 11, the wall 8 and casing 9 together forming a duct 12 through which compressed air is channelled so as to provide a stream of cooling air to pass over the wall 8 and into the combustion chamber through apertures in the wall 8.

The mixture of compressed air and fuel is ignited by the plug 4 and the resulting expanded and burnt gas is directed through the turbine and into the jet pipe 7 to provide propulsive force.

In order to increase the propulsive force and afterburning apparatus is provided. This apparatus may take a variety of forms, one such being known as hot shot ignition which includes a hot shot unit coupled to a fuel supply (not shown) for pumping fuel through a pipe to an injector 17 which protrudes into the combustion chamber and to a spray nozzle 18 located in the jet pipe 7.

The injector as shown in greater detail in Figure comprises a tubular body 19 having a nozzle 21 at one end and a screw coupling 22 at the other for making connection with the fuel output of the hot shot unit 15. A passage 23 extends through the tubular body 19. A mounting flange 25 extends through the tubular body 19. The mounting flange 25 on the body 19 adjacent the nozzle 21 enables the injector to be secured to the outer casing 9 of the combustion chamber with the nozzle 21 protruding into the combustion chamber. Another mounting flange 26 is located on the body 19 adjacent the screw coupling 22 to enable the body to be secured to the enclosing wall 11.

In operation the hot shot unit 15 pumps fuel to both nozzles 18 and 21. Fuel is expelled from nozzle 21 as the stream which is ignited during its passage through the combustion chamber, the flaming stream passing through the turbine 6 as a hot streak of flame and so into the jet pipe 7 where it ignites the fuel being sprayed into the nozzle 18. Upon combustion of the spray fuel the temperature of the exhaust gas already flowing through the jet pipe increases and the expanding gases accelerate through the pipes to provide the required additional thrust.

The passage 23 in the injector 17 is liable to become blocked by carbon debris deposited by the fuel in the passage due to the temperature in the passage and as a consequence it is necessary to remove the injector for cleaning at regular intervals.

Referring to figure 3 a spring 30 is housed within injector body 19. The spring 30 is of shorter length than the straight length of bore 23 and the spring rate is selected so that fuel pressure of up to 870 psi will produce initial compression flexing. In certain engines the fuel

injector 17 is positioned in the base of the engine and points upwards so that the input to the ejection point of the fuel is at the lowest point. As fuel passes down through bore 23 containing spring 30, the spring 30 moves longitudinally relative to the injector body 19, in the direction of the fuel. The pressure drop along the spring caused by the passage of the fuel pushes spring 30 back up the bore thus effectively scouring the inner surfaces of bore 23 and thus removing carbon. When the fuel flow ceases spring 30 drops back to the upstream end of the tube since the injector is mounted in the bottom of the combustion chamber.

The spring 30 and internal surfaces of bore 23 are coated with a low friction material which is resistant to attack by sulphur and other substances in the fuel.

Movement of the spring in the aforementioned manner serves to remove carbon deposits within the bore 23 of injector 17.

CLAIMS

1. A gas turbine engine afterburner igniter comprising fuel duct means for injecting a jet of fuel into a gas stream directed into a combustion chamber characterised in that moveable resilient means is provided within said fuel duct means such that during operation said resilient means moves relative to said duct means due to the passage of fuel within said fuel duct so as to abrade at least some of the internal surface of the bore of said duct.

2. A gas turbine engine afterburner as claimed in claim 1 characterised in that said resilient means is a spring.

3. A gas turbine engine afterburner as claimed in claim 1 or claim 2 characterised in that said spring length is shorter than the length of the bore of said fuel duct means.

4. A gas turbine engine afterburner as claimed in claims 1 to 3 characterised in that movement of said spring relative to said duct, is in one direction dependent upon the passage of fuel flow through said bore and movement relative to said duct in another direction is dependent upon gravity.

5. A gas turbine engine afterburner as claimed in claims 1 to 4 characterised in that said spring is provided with a low friction coating.

6. A gas turbine engine afterburner as claimed in any one of the preceding claims characterised in that the internal surface of said bore of said duct is provided with a low friction coating.

7. A gas turbine engine afterburner substantially as described herein with reference to the embodiment as illustrated in figure 3 of the accompanying drawings.

ABSTRACT

A gas turbine engine afterburner igniter is provided with primary fuel duct means for injecting a jet of fuel into a gas stream directed into a combustion chamber. A spring is positioned within the bore of said fuel duct The spring being moveable relative to said duct such that during operation said spring moves downstream though the bore due to the passage of fuel therein and returns to it's original position thereafter. During operation the spring abrades the internal surface of the bore thus removing carbon deposits.

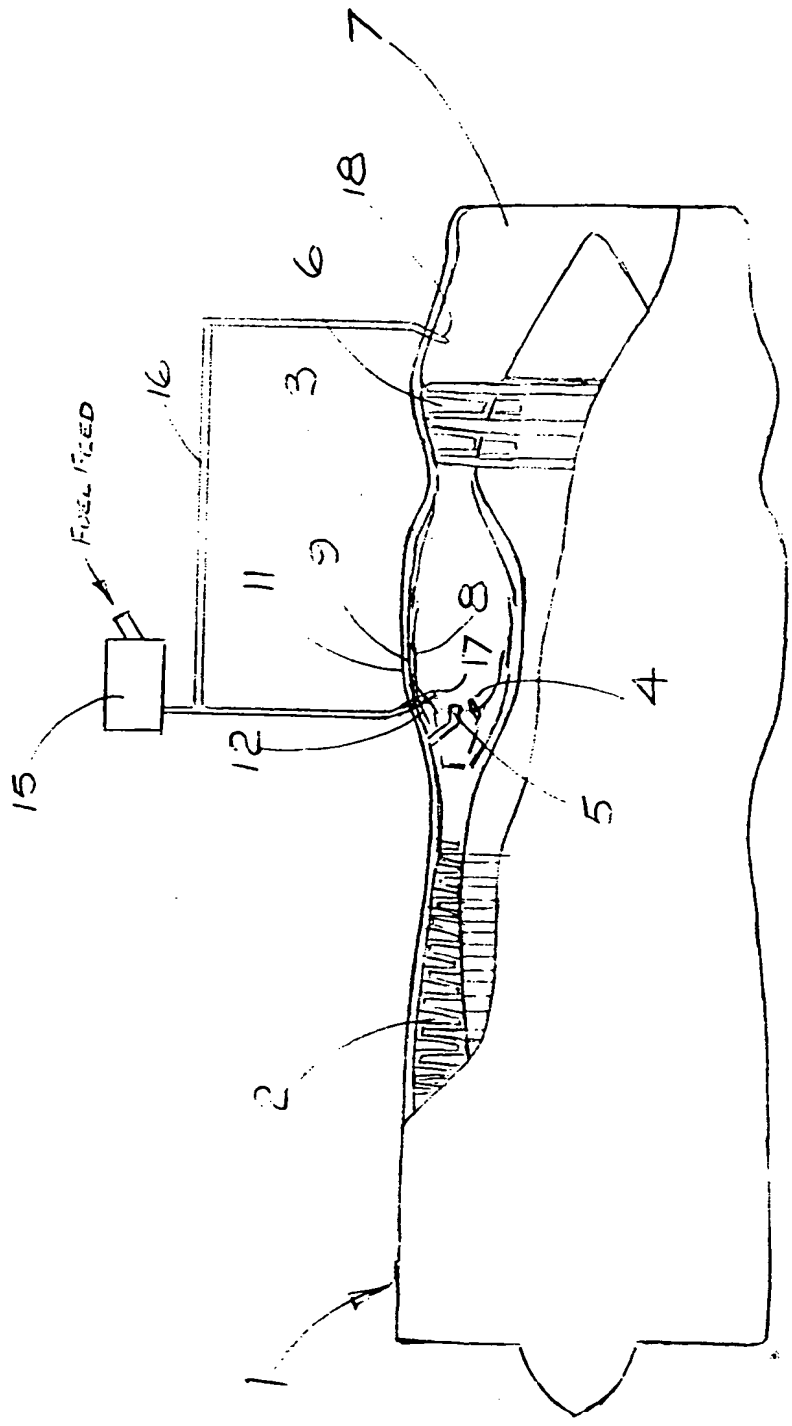

FIG 1

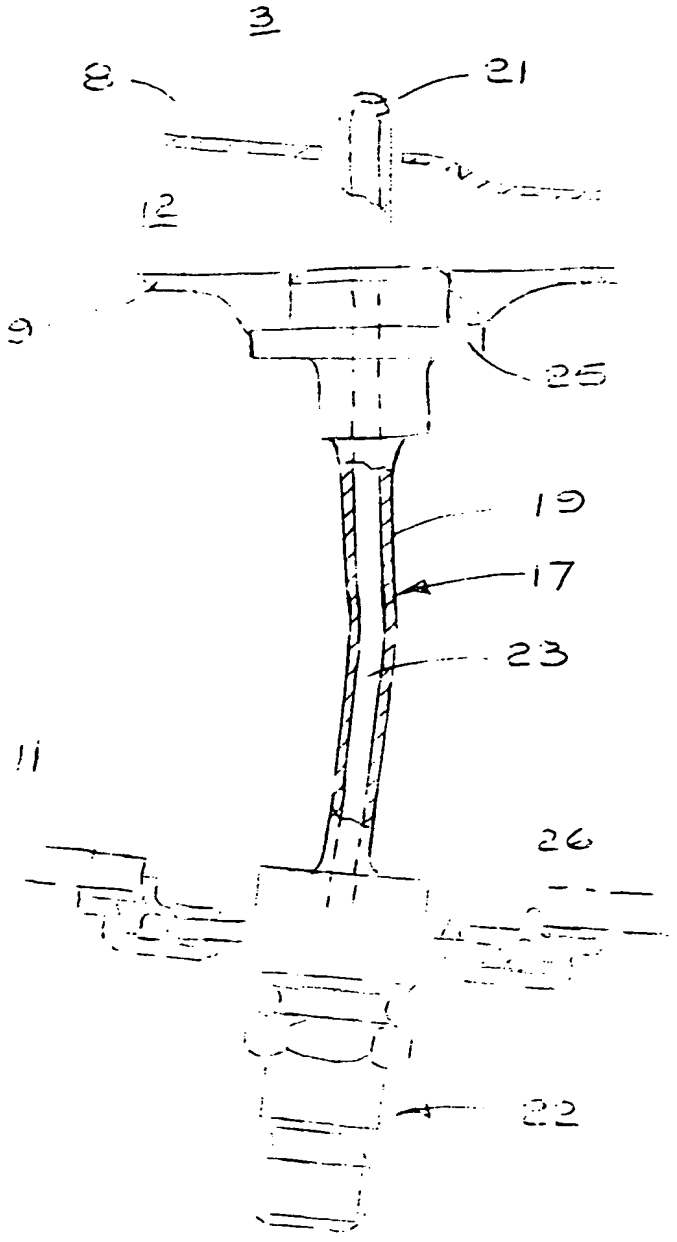

FIG 2

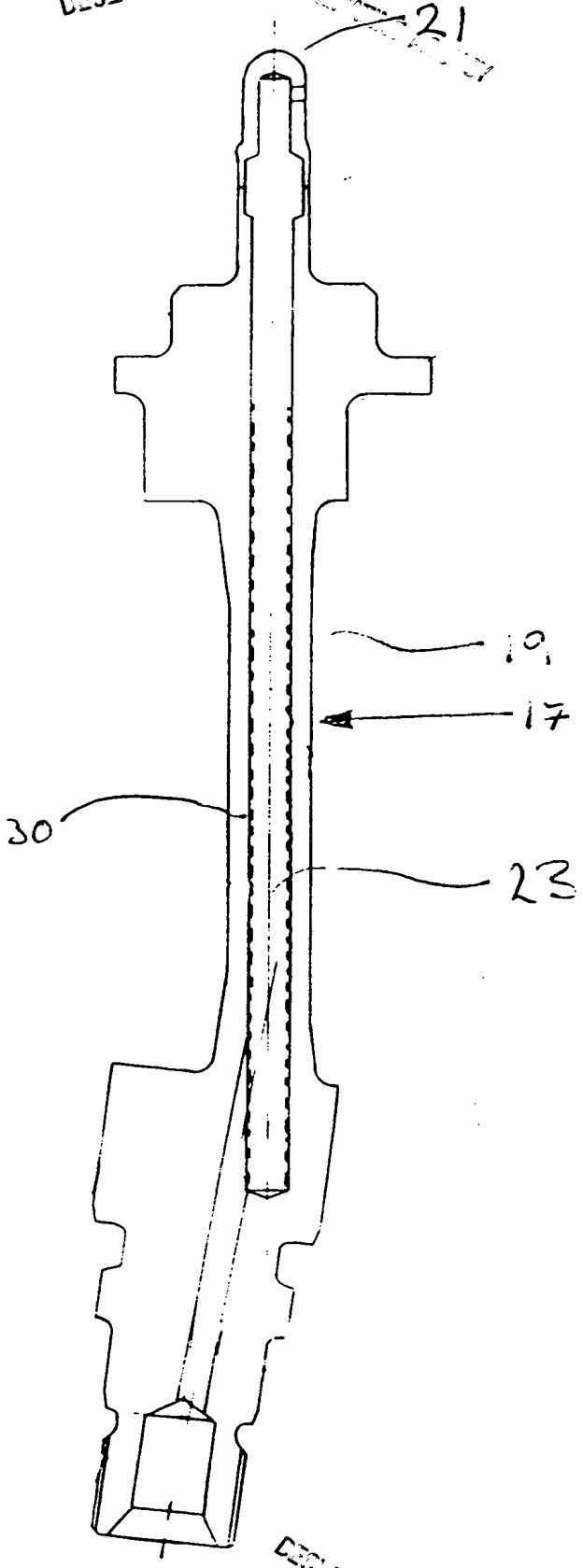

FIG 3